

# Environmentally Sensitive Maintenance Practices for Dirt and Gravel Roads

## Chapter 6: Environmentally Sensitive Maintenance Practices: Roadsides and Streams

### 6.1 Introduction

Throughout the previous discussions of natural systems and road maintenance, we have shown how the road and environment are deeply intertwined. That is particularly true of the relationship between roadsides and streams. Traditional road maintenance activities for shoulder, ditch, and roadsides frequently include undercutting stable slopes, removing valuable vegetative cover from roadside banks, and a failure to re-stabilize unprotected soil.

The greatest failing of traditional maintenance practices is in the underlying belief of many road managers that roadside vegetation is unwelcome. When road maintenance activities leave bare soil, the resultant [erosion](#) and deposition of [sediment](#) into critical drainage facilities creates the need for more frequent maintenance cycles. This becomes a self-perpetuating cycle of maintenance and pollution with unacceptable costs to local governments and unacceptable detrimental results to the environment.

As our machinery has become larger and more powerful, in many cases, we have lost touch with basic principles of nature and natural systems; we have fallen into a belief that we can work to set standards, forcing nature to comply to our will. Often the natural consequence of our actions is in direct conflict with our maintenance goal. [Environmentally sensitive maintenance](#) practices take into account road maintenance goals and natural principles to provide cost effective longer-term solutions to traditional cyclical maintenance activities.



**6-01 Typical roadside erosion problems.**

In this chapter, [environmentally sensitive maintenance](#) practices will be presented to deal with the necessary activities of roadside vegetation management and bank stabilization. A short discussion of stream bank maintenance around cross pipes and bridges for stream crossings is also included.

## 6.2 Expectations of a Finished Product

Even without an understanding of natural systems, road managers usually are well aware of the roads in their network that require less maintenance. Roads requiring less maintenance frequently are working in harmony with natural principles. The road manager would be wise to “read” these roads, comparing them with their problem roads with excessive maintenance.

In this section we want to step out of the box of traditional standards and expectations. Roads that look like they are in harmony with nature, require less money to maintain, pollute less, and offer the additional benefit of being beautiful.

Most of us have been around long enough to witness the incredible advances in machinery over the last forty years. Although some local governments move forward faster than others, most counties and townships are vastly better equipped today than they were twenty-five years ago. As our equipment has gotten better, so too have our projects gotten larger. Generally, local governments have effectively updated their dirt and gravel road networks that so well serve the citizens and industries of their communities.

The development of our state and federal highway systems has in many ways provided guidance and expectations to local governments and citizens for how their roads should look. We as local officials and road managers, however, need to look at and develop guidelines for our roads that fit the use and needs of our own communities. These local roads provide a very different link in our national highway system.



**6-02 When a road is working well within the environment, minimal maintenance will be required.**

A natural systems approach to road maintenance requires changing expectations and behaviors. When a road is working well within the environment, minimal maintenance should be required. A road that requires continual maintenance attention is probably working against natural principles. Simply asking the question, “Does it look right?” can provide terrific insight. However, the “right” that forms the comparison must be a road that is in harmony with nature. Herein lies a problem if we try to use standards and practices developed for superhighways and interstates.

## 6.3 Practices Related to Roadsides

**6.3.1 Vegetation Management.** Tree trimming and removal, brushing, brush cutting, right-of-way clearing are all terms for vegetation management. These activities are common, and road managers may need to perform these activities for a variety of reasons. We need to look at these common practices and reasons and determine what is best for our roads and our municipality.

Roadside vegetation plays an important part in our road maintenance program. Understanding the natural systems allows us to use these systems to help in more effective road maintenance.

**6.3.2 Equipment and Methods.** First, let's examine typical roadside maintenance equipment and methods and evaluate their effectiveness in all areas of road maintenance, the environment, and community relations.

The normal methods used to trim trees, remove brush and cut vegetation along roadsides include manual methods with manual equipment such as chainsaws, string trimmers, and hand pruners; mechanical methods with mowers and brush cutters; and chemical methods with chemical application equipment and herbicides. All of these methods and equipment have their place in an integrated vegetation management program and can be used effectively. There are some cautions, however, that should be noted.



**6-03 Roadside Vegetation Management Options.**

In an [environmentally sensitive maintenance](#) program, chemical methods using herbicides are certainly the first concern. There are many potential problems associated with the use of herbicides. As a result, numerous federal laws and regulations govern their use. States have also adopted regulations, patterned after the federal laws, regarding the use of chemicals for vegetation control. These regulations require local government applicators to become certified through testing. [Environmentally sensitive maintenance](#) does not promote the use of herbicides. If you do use herbicides, you need to become familiar with the laws and follow all the requirements and regulations associated with herbicides use.

Because roadside vegetation management is labor-intensive, boom mowers have become increasingly popular. The boom mower, properly used, is a labor saver and can be safer than other equipment such as chainsaws. However, one only has to travel down a road on which a boom mower was used to totally destroy the roadside vegetation, leaving a hurricane-aftermath look, to realize that the use of this equipment can get out of hand. Damage to large tree limbs can eventually kill the total tree. Refer to the discussion in Chapter 4 on understanding your trees and the effects of wounds.

Boom mowers also raise some roadside safety issues. Using a boom mower to cut down young saplings, leaving those “spikes” behind, can result in a very unsafe condition. Motorcyclists or bicyclists who may skid off the road and upset can be impaled on these “spikes,” causing severe injury or death, not to mention the resulting tort liability claims.

Boom mowers and their resulting destruction can also be a public relations headache. Many complaints have been lodged against both state and local governments about the “butchering” of roadside vegetation.



**6-04 Boom mower impalers!**

**6.3.3 Roadside Clearing.** Traditional right-of-way clearing, or “[daylighting](#)” practice, often creates problems for roadside vegetation for our dirt and gravel roads. These practices may have their place on the interstates and superhighways, but often they cause increased maintenance work on gravel roads in forested areas.

Common accepted reasons for clearing the roadside of trees and bushes are:

1. Eliminate shade
2. Improve roadside visibility
3. Establish a safety “clear zone”
4. Reduce routine trimming.

All of these reasons have some merit and may apply for some roads, but a more thorough understanding of the conditions encountered on dirt and gravel roads, and the consequences of inappropriate roadside clearing, is necessary to make effective decisions.

**6.3.3.1 Shading, Good or Bad?** Brush cutting, trimming, and tree removal for the purpose of eliminating or reducing shading is probably the most common roadside management practice, other than roadside mowing of grass. A great deal of money is invested in vegetation management for shade reduction each year. The goal of improved public safety is universal and laudable. On low traffic dirt and gravel roads, however, excess tree removal can have the dire consequences of increasing speeds to unsafe limits.



**6-05 The disadvantages of shade: retains moisture to promote icing, reduces visibility.**

Why should we eliminate shading? Here are the reasons:

1. Shading retains road moisture, promoting unsafe conditions such as icing in the winter.
2. Shading also reduces visibility and limits the “clear zone,” again affecting safety.

An abrupt transition from bright sunlight to dense shade or vice versa can be a great safety hazard. Extreme changes in light can have a devastating effect on the motorists’ visibility and be a direct cause of accidents. Extreme changes in light conditions should be avoided.

Shading, however, also has advantages. Shading:

1. helps retain road moisture, reducing [dust](#);
2. reduces growth of colonizer plant species and encourages desirable herbaceous plant growth (discussed below);
3. is more aesthetically pleasing, contributing to tourism and the economy.



**6-06 Bright sunlight to dense shade or vice versa – major visibility safety hazard – should be avoided.**

With this information, we may want to look at shading with a new perspective. A limited amount of shading may be more effective and efficient for our road maintenance and the environment.

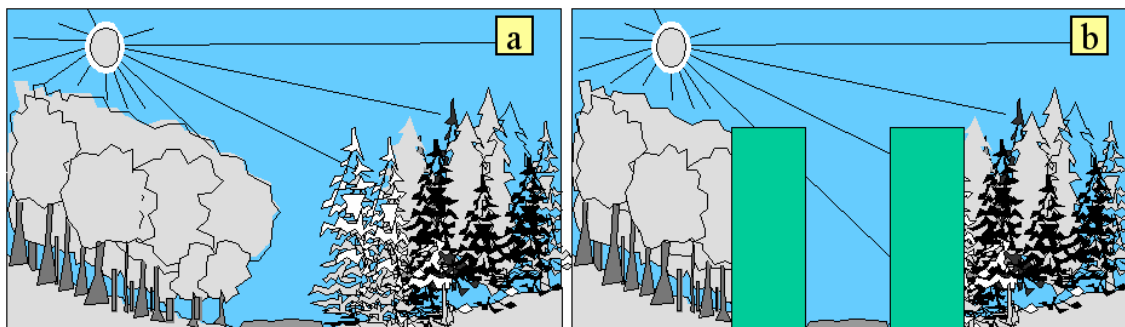
**6.3.3.2 Problems with Traditional Clearing Techniques.** Traditional clearing techniques involve total removal of brush and vegetation along the roadside from right-of-way line to right-of-way line, typically resulting in vastly increased sunlight along the edge of the road. So, if increased sunlight is the goal, what is the problem?

If we could view time-lapse photos of the road and its surrounding environment following a traditional roadside clearing before doing it, we would see it is not the best or most effective practice. If the roadside is wooded or forested and the road well shaded and we automatically go in and cut everything down, as shown in Figure 6-1a to 1b, on each side of the road for whatever distance we consider necessary, let's observe what happens.

The forest trees, by nature, have grown structurally as a forest, meaning that each tree can depend on surrounding trees for protection against the elements. When a section of trees is cut down, the remaining trees along the cut edge are open to storms and wind and may not be structurally strong enough to withstand these conditions. Wind damage, broken branches, and even uprooting can result, as shown in Figure 6-2a.

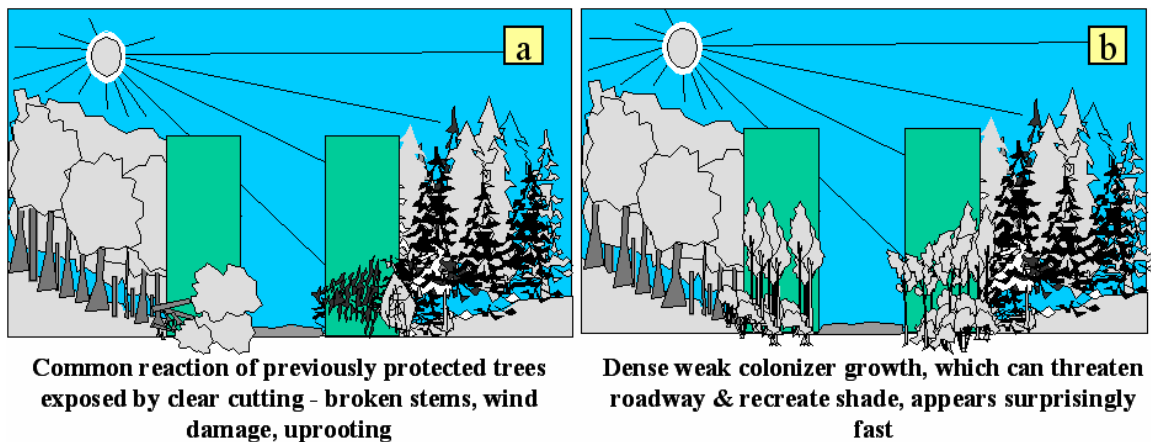


6-07 The advantages of shade.



Traditional clearing practice for a shaded road would be from right-of-way line to right-of-way line

Figure 6-1



**Figure 6-2**

Additional problems with common clearing practices include the rapid regrowth of the removed trees through stump sprouting. These stump sprouts are weak in structure and can become a continual maintenance problem.

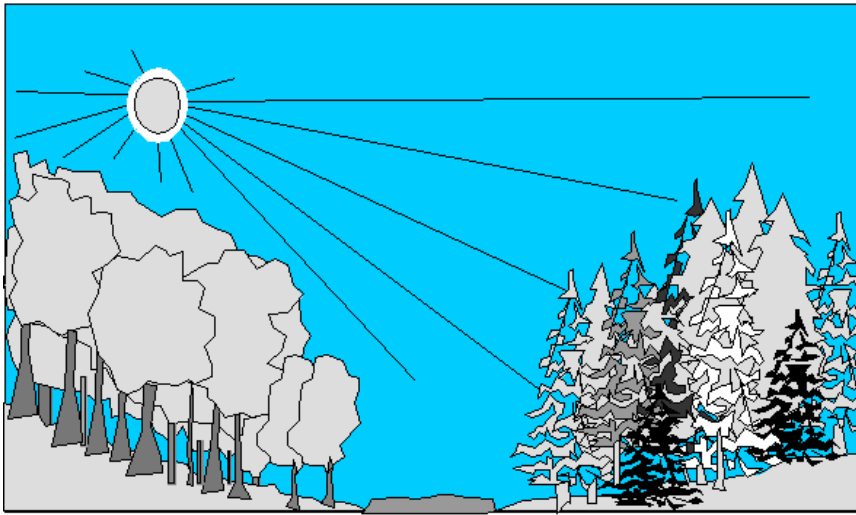
When large quantities of trees and vegetation are removed, previously protected plants, now exposed to full sun, begin to fail. A formerly shaded roadside with low growing, broad-leafed ground cover vegetation becomes a completely different ecosystem when exposed to full sun. Exposing low growing, broad-leafed, shade-tolerant plants to full sunlight typically kills them, with the potential of soil [erosion](#).

Unfortunately, when the roadside, which was previously shaded, receive full sunlight, nature produces vigorous growth, as depicted in Figure 6-2b. This vigorous growth is due to the invasion of colonizer species that are most attracted to this environment, but are the worst possible roadside plants. Colonizer species, which we described in Chapter 4, Section 4.5.4 on succession, are fast-growing, weak growth types. [Colonizer trees](#) can threaten the roadway safety and recreate shade. These [colonizer trees](#) then become extremely high maintenance roadside plants. In many cases the plants we most want to remove are the plants most encouraged by our efforts. This creates the need to mow and trim in increasingly frequent cycles.



**6-08 You do not need fast-growing weak-structured colonizer-type roadside trees!**

So in this scenario, the mowing/removal of trees and brush in the interest of safety and visibility, have the opposite effect, starting an endless cycle of cutting and re-cutting of this colonizer growth.



**Selective trimming retains some shading to protect roadside soils and forest edge & still allow drying of road bed**

**Figure 6-3**

**6.3.3.3 Alternative Techniques.** The solution is to **use the forest system to reduce maintenance.** By taking advantage of natural principles, it is possible to create safe clearances, provide enough shade to control [dust](#) and invasive species, and eliminate the invasive rapid re-growth of colonizer

species and frequent mowing cycles. We need to develop a strategy following some basic guidelines.



**6-09 Remove dead, diseased, unstable, or dying trees first.**

Be selective! When doing roadside trimming and tree removal, remember to remove the dead, dying, unstable, or damaged trees first. Trees that have been damaged by previous maintenance activities, automobile accidents, etc. will eventually die and become hazards.

The second priority should be to remove the existing [colonizer trees](#). These trees, even if they are healthy, are not good roadside trees. They are very rapid growers and have weak wood and short lives. They commonly fall onto the road or drop limbs, which create maintenance and hazards.

After removing the damaged trees and the colonizers, it is advisable to look the situation over and evaluate the rest of

the trees. Maintaining strong, slow-growing, deep-rooted climax species should be an objective (refer to chapter 4, Section 4.5.4). Avoid straight-line cutting, however, favoring instead an irregular edge. Traffic will tend to travel more slowly on a road with an irregular edge. Speed has always been a major safety problem for our dirt and gravel

roads. Clearing the roadside completely or cutting back on a straight line parallel to the road gives the motorist the safe illusion to increase speed.

Maintaining a uniform level of shading is best. One of the greatest dangers from shading comes from winter conditions where pockets of deep shade create irregular icing conditions. The objective should be to thin the canopy to achieve the desired shade density.

Sometimes it is necessary to thin back off the edge of the right-of-way, as the desired sunlight may only be available from the side, not from above. Obviously it is necessary to discuss any plans and objectives with property owners to receive permission to work off the right-of-way.



**6-10 Pockets of deep shade can create irregular winter icing conditions.**

**6.3.3.4 Adjacent Residents and Off Right-of-Way Work.** Local governments must have a public relations strategy. Road managers should meet with the property owners where brush cutting/trimming is proposed. This local government representative should discuss the plan to do brush cutting with the property owner, offering to walk the roadside and specifically discuss the goal of the project and to take into consideration the property owner's concerns. This one-on-one contact with the property owner prior to the actual cutting of brush or trees is critical. It establishes a level of respect for the property owner, something that is commonly overlooked. It is especially helpful to walk the road with the property owner. When a tree is infringing on the travel-way or an obvious threat of falling into the roadway, it is easier to recognize the problem when both parties are standing right there looking at it. Listening to the property owner's concerns and developing a plan that meets both parties' needs is vital to the success of a roadside management plan.



**6-11 Before and after look at selective tree trimming during a road project – letting in more sunlight with less shade – striking a balance.**

**6.3.3.5 Advantages of Using the Forest System.** In a situation where a dirt and gravel road is heavily lined with trees or passes through forested areas, a vegetation management program that uses the forest system to take advantage of natural principles can save time and money in several ways.

1. Moisture is nature's stabilizing agent. Allowing enough shade to hold some moisture on dirt and gravel roads helps to hold the surface together and reduce [dust](#). Although few road managers would readily identify moisture retention as a benefit of shaded roads, they will almost always tell you they use less dust control in shaded areas.

2. Maintaining shade along our roads reduces the establishment of colonizer species (aspen, birch, poplar, sumac, striped maple, etc.). These rapidly growing, weak-wooded trees create the biggest maintenance problems, especially during winter maintenance operations. (They lean out in the roadways with snow load.)



**6-12 Would anyone want to plow this road?**

3. The trees that are removed are less likely to return as stump sprouts if shade is retained. All of us have witnessed the rapid return of vegetation under new power line cuts. This is usually a combination of stump sprouts and colonizer species. This scenario can be avoided by simply allowing the road to remain partially shaded.

**6.3.3.6 A Common Pitfall in Tree Removal.** All of these techniques will reduce the frequency and cost of roadside vegetation maintenance. Importantly, at no time in our discussion of vegetation management has a diameter or size been mentioned as a criterion

for what to remove and what to leave. Herein lies one of the biggest problems with boom mowers. Boom mower operators are frequently instructed to cut “everything you can reach and everything small enough that you can cut.” This direction and practice will ultimately have, as its consequence, roadsides vegetated only by large trees. If these trees are the right species and are in good health, this might be a defensible practice.

Boom mowers may be effective in maintaining right-of-way, but great care should be exercised when using them to re-establish those long neglected rights-of-way. When decisions are based solely on size, damaged and potentially hazardous trees are left while the potentially stronger, healthier replacement trees are removed. Often this leaves a roadside stimulated into vigorous growth by excessive sunlight. In the case of boom mowers, what is perceived as the “easiest way” may actually be the most expensive.

Additionally, some of the most beautiful, slow-growing, strong, wildlife-friendly trees along the roads are being systematically removed because they have the misfortune of being small. Dogwood trees and serviceberry trees are some of nature’s finest work and are frequently chosen as roadside trees by planners. Yet they are often removed by boom mower operations just because of their size. Would it not have been better to remove the big old damaged or dead trees and save those small dogwoods? The dogwood makes an excellent roadside tree with the added value of blossoms to beautify the roadside in the spring.

**6.3.3.7 Tree Leaves.** What road maintenance person hasn’t uttered unmentionable language concerning leaf problems? Leaves in ditches, leaves on the road - leaves! leaves! leaves! Fall can be a beautiful time of the year with the diverse coloration of the landscape from the changing of the leaves. This seasonal occurrence concludes, however, with the leaves falling to the ground and filling ditches and covering roadways. If we are adding road material, the layer of leaves can become a problem if not removed. If the layer is substantial, the slow composition of the leaves can result in a slip plane for road material to slide. In addition, leaves fill the roadside ditches and interfere with proper drainage, clogging ditches and crosspipes when the rains come.



**6-13 Dogwoods are a good roadside tree with the added value of spring blossoms.**

Leaf removal can be labor intensive and burdensome to the road maintenance crews. Backpack blowers or wheeled walk-behind power blowers are often used to blow leaves off the road prior to aggregate placement. Leaf cleaning in the ditches can be accomplished by the usual grading of ditches, removing the leaves and possibly the existing vegetation lining that may not have time to re-establish prior to winter.



**6-14 Leaf Blowers to Clean Ditches and the Roadway**

The job can be made easier with a three-point hitch leaf blower. These are the same machines used by many golf courses. By using this type of blower, we can save time and effort. The machine is easy to use and relatively inexpensive considering the amount of leaf blowing needed on many road systems.

Blowing the leaves off the road and out of the ditches and leaving them to decompose in the natural roadside environment is definitely environmentally sensitive. In addition, we reap the benefit of not losing soil and existing vegetation through a ditch grading operation, which would open the potential for additional [erosion](#) and [sediment](#).

**6.3.4 Using Other Plants for the Roadside.** In addition to maintaining limited shading, there are many low maintenance plants that readily grow on roadsides. Deciding what plants to encourage on a given site involves many factors. Often maintenance practice, such as mowing, can be timed to encourage some plants while discouraging others. Plants such as day lilies and ferns are examples of low maintenance plants that do a terrific job of holding soil in place and limiting growth of invasive species. Day lilies and ferns do not benefit from mowing. Wherever possible, care should be taken to leave these plants intact during a mowing cycle. Unless they create a visibility problem, there is no benefit to mowing these plants. If invasion of woody plants into fern or day lilies is a concern, time mowing operations for the dormant seasons of the year. Visibility is better at this time also.



**6-15 Day lilies or ferns are good roadside plants – low maintenance, aesthetically pleasing**

When doing shoulder cutting or ditch cleaning, if the berm or spoil material is full of sod with day lilies or ferns, we should use this material to our advantage. Pick a bank where there have been problems holding the soil in place and coat it with six inches or more of dirt full of sod and weeds and lilies and whatever else. In no time at all these plants will become established on the new soil. Obviously care should be taken to provide some type of temporary [erosion](#) control for the time it takes the plants to become established. It is a lot easier to vegetate soil, which is naturally full of plants, than to get plants to grow from seed on hand-polished subsoil. Remember our discussions in Chapter 2 on topsoil and subsoil.

Grass, of course, is a wonderful roadside plant. Because of how it grows, (refer to Chapter 4, section 4.5.2 Plant Basics) grass is usually not affected by mowing. Grass holds soil in place and helps slow the speed of surface [runoff](#). Grass also traps [sediment](#) that is moving with the water. The benefits of grass from an environmental point of view are obvious. The benefit of grass from the perspective of a road manager should also be obvious, but frequently it is unrecognized.



**6-16 Grasses make good roadside plants, establishing surface erosion protection**

Other vegetation can be used to reduce maintenance in many roadside situations. By encouraging appropriate plants for the location and terrain, maintenance can be minimized and the environment enhanced. Deep-rooted species can be used for soil reinforcement. Ground covers can be used for surface [erosion](#) prevention. Species selection for these applications should consider low or no maintenance.

Working with our local and state conservation agencies on appropriate plants for specific sites is always a good idea. We'll be discussing site evaluation in a little more detail below.

**6.3.5 Clearing Stream Banks at Cross Pipes.** In Chapter 2, we discussed the historical aspects of how so many roads were built close to streams. With so many roads adjacent to streams, we have many stream crossings with associated [culvert](#) pipes and bridges. Maintenance around these structures consumes great quantities of time and money for local governments. As science has learned more about water and how it behaves around restrictions in flow, better bridges and [culverts](#) have been designed and built. The stream saver system along with the section on better bridges described in Chapter 5 is a great step forward in reducing maintenance and pollution at stream crossings.

**6.3.5.1 Common Practice and Associated Problems.** We need to zero in on the specific maintenance operation of clearing brush and trees from stream or channel banks adjacent to these crossings. Traditionally, common practice has been to clear stream banks upstream and downstream from a roadway cross [culvert](#) or bridge to clear the floodway and improve drainage. Doing so left the crossing with a cleaner look and presumably easier maintenance. But are these assumptions really valid?



**6-17 Clearing stream banks for a road crosspipe replacement can have devastating effects on the stream and future maintenance.**

Although taken during different seasons of the year, look at the before and after, Photo 6-17, of a crosspipe replacement project and consider some of the potential problems. Referring back to Chapter 4, the stream shading is reduced, affecting stream temperature, which in turn affects the stream habitat. [Outside inputs](#) of vegetation debris vital to stream life are eliminated, and the streamside habitat is reduced. Look at the stream width upstream of the work area and within the work area. Would fisherman fish this area, or would they go upstream to find the natural shady 'holes'? These are all environmentally related.

Widening the stream causes the water flow to spread out and slow down, resulting in deposition of material immediately prior to the new crosspipe. It should also be apparent that any debris coming down the stream will be deposited at the road [culvert](#) or bridge, with possible blockage of drainage openings and subsequent flooding damage at the road or bridge.

Clearing the floodway to improve drainage could also have the unintended consequence of causing flooding downstream. The fact is that improved drainage usually means faster water. Faster drainage of a [watershed](#) means more water at one time with potential flooding downstream.

**6.3.5.2 Alternative Practices.** The alternative technique, or [environmentally sensitive maintenance](#) practice for stream bank/stream crossing vegetation is very easy: “DO NOTHING!” The natural stream channel will have less influence on the road crossing and cause less maintenance. The “before” Photo 6-17 emphasizes the fact that any large debris will get hung up long before it gets to the crosspipe.

Sometimes it is impossible to do nothing; some streams produce so much debris that large pieces upstream from the road have to be removed. Common sense dictates that some vegetation maintenance such as selective thinning may be required. The message is to look at what is being done and ask if it is necessary or it has any benefit. The less we disturb streams and stream bank vegetation around our pipes and bridges, the better for the environment and reduced future maintenance. If vegetation has to be removed at the immediate worksite for room to work, trim to the ground. The vegetation will grow back and again create a more natural low-maintenance site. So the solution is to either do nothing (avoid) or do only what is absolutely necessary (minimize).

**6.3.5.3 Benefits of a New Approach.** Vegetation in the floodway catches a lot of the debris in high water flows, spreads and slows the water flow, allowing gradual escape or release of water without letting the debris clog the drainage pipe or bridge opening

There are other benefits of woody type vegetation around pipes and bridges. Although grass has roots and does act as an [erosion](#) preventer by holding soil in place, these roots are shallow surface roots. Woody vegetation commonly has deeper roots and offers greater soil reinforcement around stream and road banks. This extra reinforcement is especially needed at bridges and pipes where water is forced to change direction or speed, causing much more turbulence and the potential for [erosion](#) and scour.

Streamside vegetation also shades the stream. The stream ecosystem is very temperature sensitive. Raising the water temperature can have dire consequences for species living in the stream. Additionally, vegetation along streams provides habitat for numerous species critical to the aquatic ecosystem along with those important [outside inputs](#) vital as the food link in the aquatic food web.

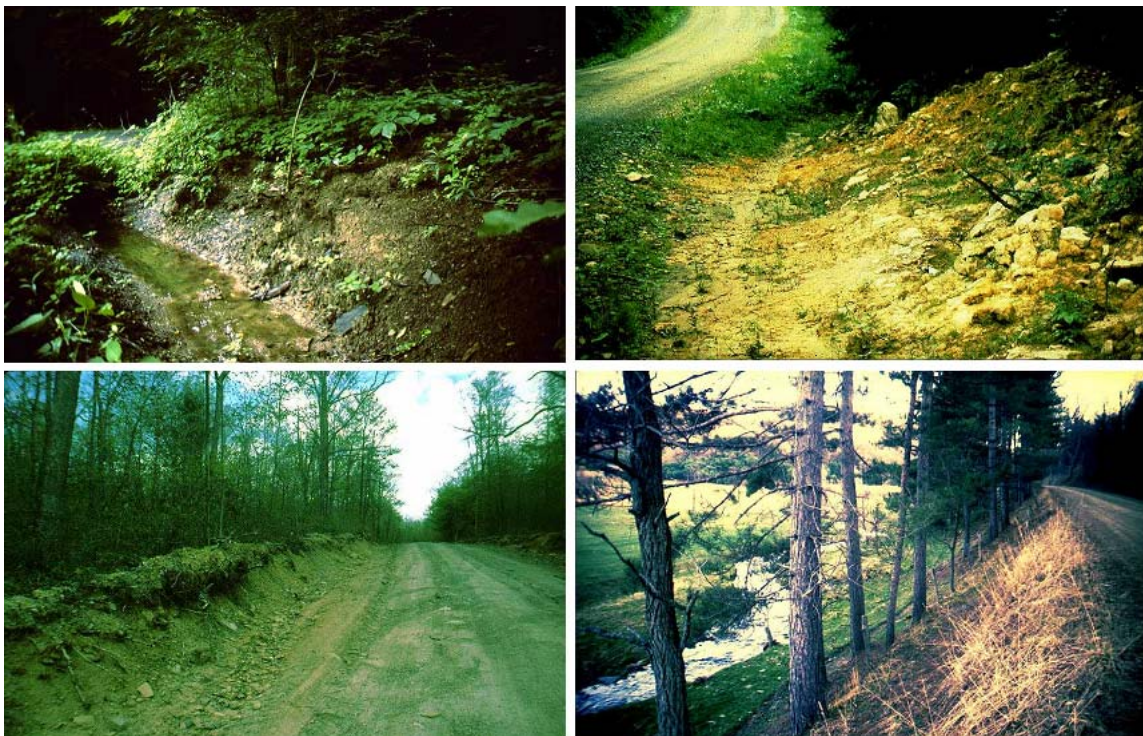
All of these benefits result in a better environment, less maintenance in keeping the banks cleaned or mowed and the pipes clear and open, and less potential of flooding at the site or downstream.

Although this section dealt with clearing of stream or channel banks at a roadway cross pipe, the next section deals with the stabilization of road and stream banks.

## 6.4 Practices Related to Road and Stream Banks

In discussing roadsides, roadside banks and stream banks are always a large issue. Our road and streams banks are constant sources of [erosion](#). Road banks, in particular, are constantly being disturbed and stripped of ground cover, waiting for [erosion](#) to occur. [Erosion](#) from these bare soil road banks creates ongoing maintenance headaches by filling drainage ditches and clogging pipes.

There are a few general factors that should be noted in re-establishing a stabilized bank, be it a road bank or a stream bank. Large, obvious sites with bank [erosion](#) can be easily targeted and are commonly the only ones that get taken care of. There are, however, numerous small sites of unstable eroding banks that are left unattended. An effort should be made to do a bank restoration program and include all of these small sites. When we began to add up all the existing small sites across our own local road system and then add those to all of the other sites in other local road systems, we realize that even the small ones can add up to significantly contribute [sediment](#) pollution. In addition, these small sites will only continue to get worse with time if left unattended and will eventually become the large site.



6-18 Eroded roadside banks are common sights, but add up to a large erosion and sediment pollution problem affecting both roads and the environment.

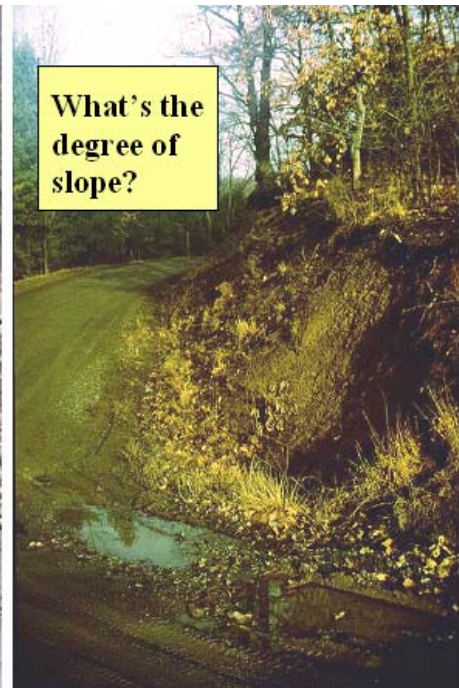
The type and physical structure of the soil is the first obstacle of plant establishment. We have already discussed the advantages of topsoil over subsoil. We also need to note that the use of heavy equipment should be limited to avoid **excessive packing** of the soil. Soil compaction can affect the amount of water penetration versus [runoff](#) and the ability of roadside vegetation to survive. Remember, when we reseed an area of our lawn, it is always recommended that we till the soil, breaking up the hard surface. Roadsides tend to have very compacted soils due to vehicles and equipment and construction and maintenance activities for the road.

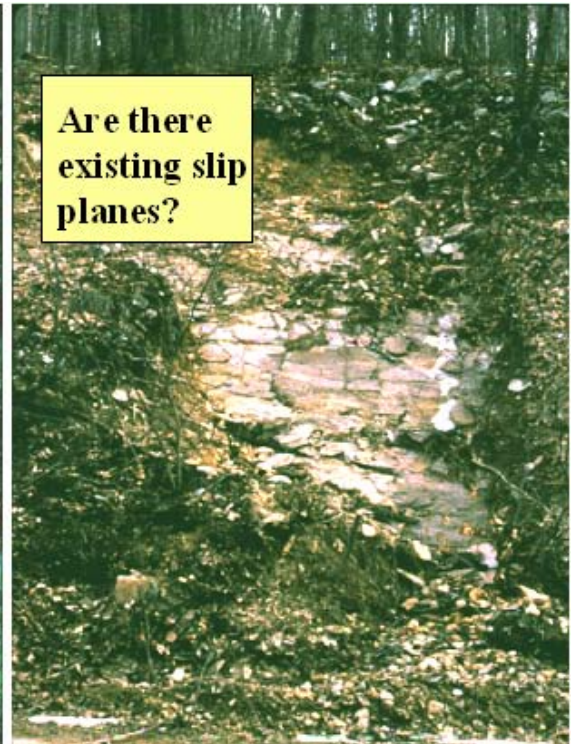
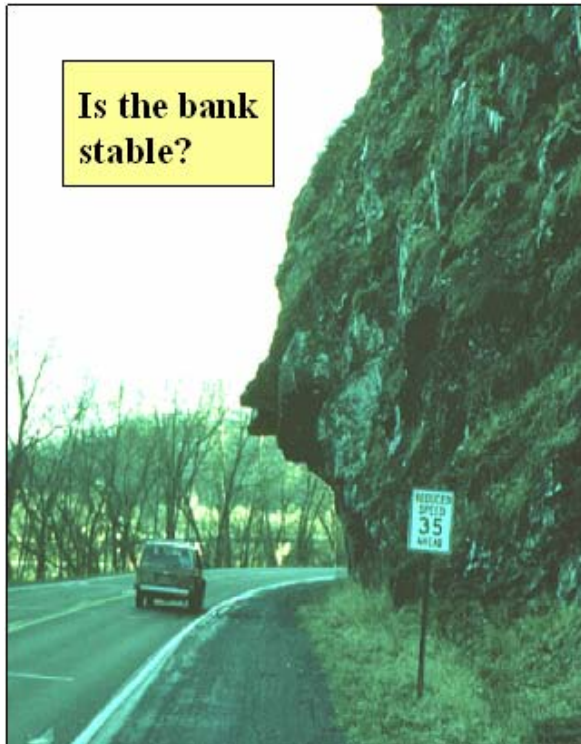
**6.4.1 Initial Site Visit.** To initiate [environmentally sensitive maintenance](#) practices for bank stabilization, a thorough investigation of the site is required. When we think about what makes a bank stable, there are several conditions that we need to determine. First, what type of material and slope do we have? Second, what is the drainage condition? And third, what is the existing vegetation, if any? These important characteristics are all interrelated and should be considered during an initial site visit.

At this initial site visit, we need to ask ourselves the specific questions listed below. Look at each of the following sets of photographs. Do these banks look familiar?

**Soils:**

1. What soil types are present?
2. What is the degree of slope?
3. Is the bank stable?
4. Are there existing slip planes undercutting the surface?





6-20

Hydrology:

1. Is the slope wet or dry?
2. Is there seepage or over the bank flow?
3. What is the condition of nearby banks?
4. What is the surrounding terrain?



6-21



6-22

### **Vegetation:**

1. What is the existing vegetation?
2. What vegetation occurs naturally in the area?
3. Are tree roots reinforcing the bank?
4. Is it shady or sunny?

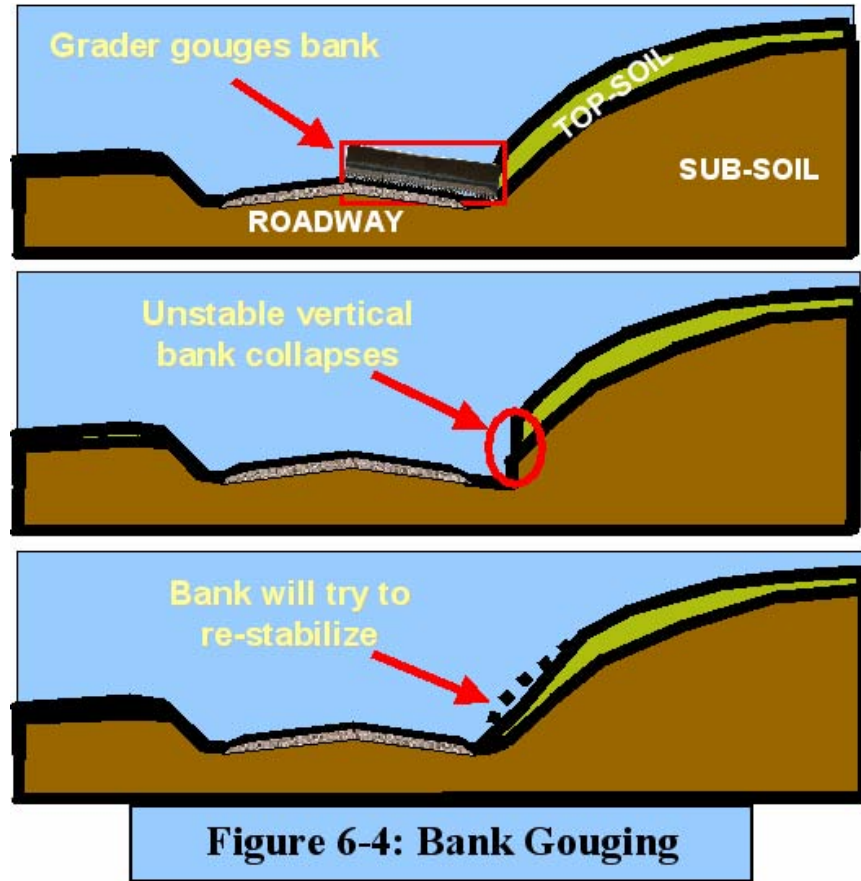


6-23



6-24

In pursuing this initial site evaluation for road and stream banks, it is wise to observe and follow the natural patterns and not disturb a stable bank. One of the most common problems is “[bank gouging](#)” during grading operations or ditch cleaning. The grader operator cuts into a stable bank and creates a vertical surface at the toe of the bank as shown in Figure 6-4. This vertical bank is unstable and will slough off as the bank tries to return to a stable



angle. As this occurs, the ditch is filled back in and the whole process starts over again with the next grading operation. Photos 6-25 show to what extremes this operation can lead and clearly indicate that, as these banks collapse, grading operations will again be required – the recurring maintenance in an endless cycle.



6-25 Unstable vertical bank will collapse.

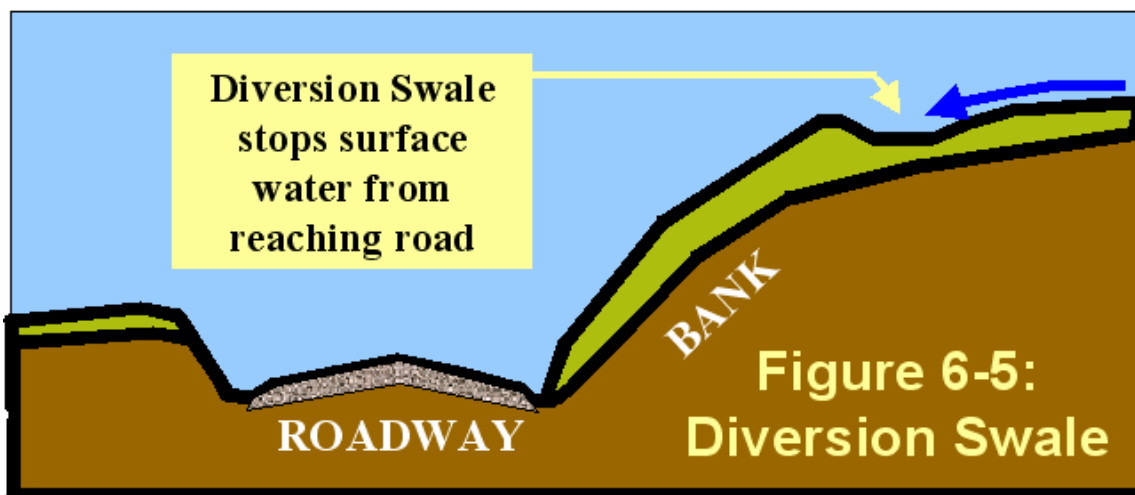


Keep in mind that tree removal can result in bank failure. The soil reinforcing roots will no longer be effective. Tree roots are mother nature's reinforcing bars, as discussed in Chapter 4, Section 4.5.2.4

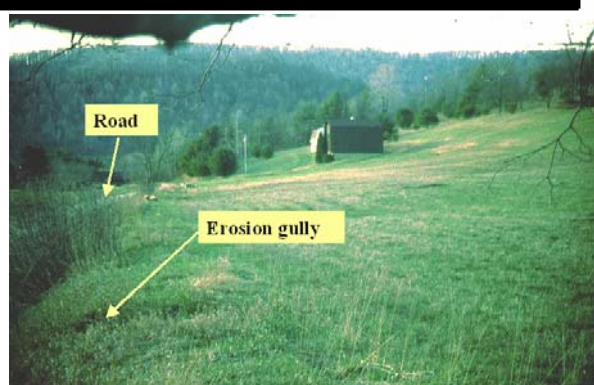
**6-26 Tree Roots: Mother Nature's Rebar.**

**6.4.2 Proven Techniques for Banks.** Once the site investigation is complete, then the selected technique or techniques can be effectively implemented. Always keep in mind the possibility of using a combination of practices. Several of these practices are commonly known and used but are still worth mentioning as good “tools” to protect both the road and the environment.

**6.4.2.1 Diversion Swales.** Diversion or interceptor swales divert upslope surface water before it washes over the top of the road bank and into the road's drainage ditch. [Diversion swales](#) reduce the volume of water to be handled by the road ditch, decreasing the size of the road ditch and potential [erosion](#) problems. They also stop the erosive forces on the face of the bank.

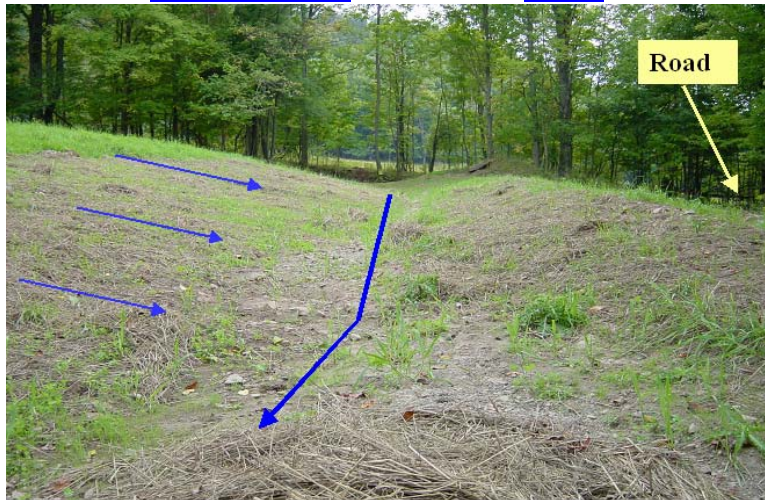


[Diversion swales](#) must be stable, with a level longitudinal grade for infiltration back into the soil or sloped to an adequate discharge area. They must contain the overland flow and not be overtopped. Diversion ditches are effective for draining low gradual vegetative slopes. Referring to Photo 6-27, this would be the ideal location to



**6-27 Ideal Location for a Diversion Swale.**

create a [diversion swale](#). The surface [runoff](#) from the entire upward slope could be



drained into a swale at the top of the road embankment. The road bank would then be protected against the [erosion](#) gullies that are now present.

[Diversion swales](#) are usually outside the right-of-way but need not interfere with agriculture. The wider and more gradual the sideslopes and longitudinal slope, the more infiltration and less accumulation of flows will result. By eliminating washouts and [erosion](#) gullies

**6-28 Diversion Swale: Wider swales and gradual slopes result in more infiltration and less water volume to handle.**

that form down over the road bank and start to “eat” back into the hillside, the swale can actually improve drainage of the landowner’s property.

**6.4.2.2 Slope Geometry.** Slope geometry is an important aspect of bank stabilization. Flattening the slopes gives greater stability and less [erosion](#) by spreading water flows out and slowing the flow velocity, in much the same way as flattening roadside ditches reduces flow velocity, as discussed in Chapter 5.

Observing and following existing natural patterns can be beneficial. Do not disturb stable areas if at all possible. And remember the value of tree roots in maintaining a stable slope. Look at the two photos. The first one shows a patchy, vegetated road bank. Vegetation has already started, but is having difficulty establishing on dead subsoil. Notice the flush of growth in the ditch area. Perhaps with a little topsoil, seed, and mulch, this area could flourish. No need for any grader work. If cleaning the ditch, make sure to clean only to the toe of slope and not to cut into that toe of slope. The second photo shows a stable revegetated bank. Here, a “Do not disturb” technique is needed.

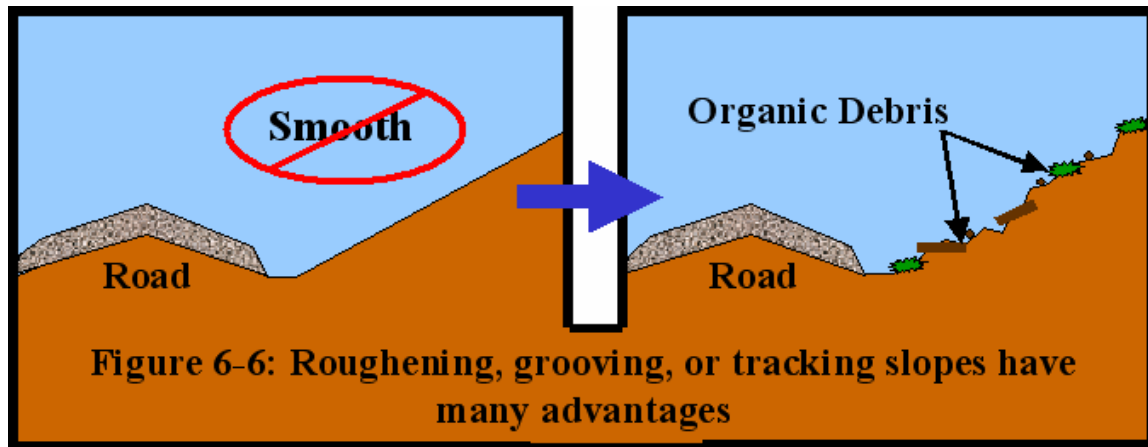


**A little help is needed!**



**“Do not disturb!”**

Roughening, grooving, or [tracking](#) slopes have distinct advantages. First, however, we need to change our perception of what a “well-dressed” bank should look like. We need to think in terms of existing natural banks. Natural banks are not regular or consistent as to surface and slope, and they are not polished and shiny. A natural appearing slope as shown in Figure 6-6, offers numerous advantages. The shined bank offers none.



As stated above, roughening, grooving, or [tracking](#) of slopes have many advantages:

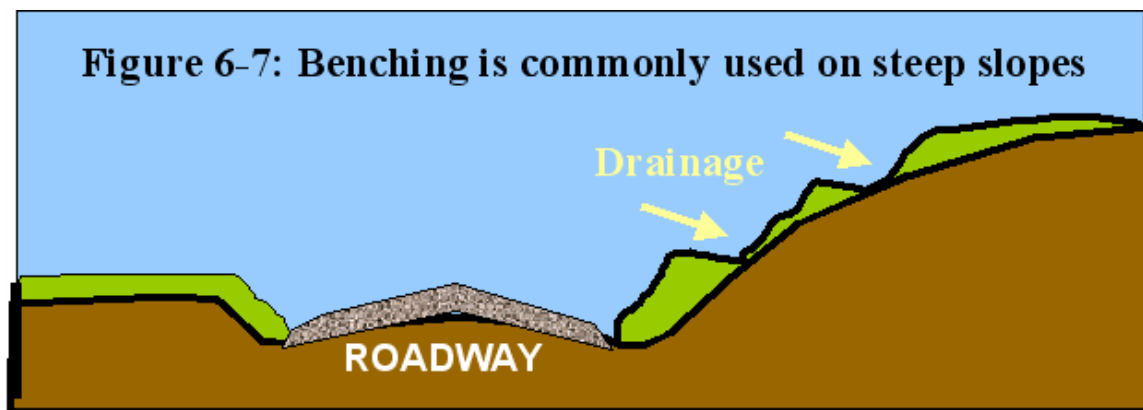
1. Catching rain water
2. Slowing surface water flow
3. Reducing [erosion](#)
4. Increasing filtration
5. Trapping [sediment](#)
6. Holding water, seeds, and mulch for enhanced vegetative growth.

These techniques require light equipment in order to prevent packing the soil to the detriment of plant growth. Track equipment should be used up and down the slope, not across, so the grooves catch water and hold seeds and mulch.

**6.4.2.3 Benching.** Benching, commonly used effectively on long, steep slopes, provides the same benefits as roughening the sloped surface. The top of the bank may have to be moved back and may be off the right-of-way. A good working relationship with property owners is required.



**6-30 Tracking the newly constructed banks.**



To be effective, the [bench](#) must collect water. The outside edge must be higher than the inner edge to prevent over the bank flow, as shown in Figure 6-7. The [bench](#) then should have a gradient to drain the [bench](#) to a proper outlet. Some benches can be gradually run out to the road ditch grade for drainage. Do not overlook the use of smaller multiple benches or steps and keeping some irregularity for a more natural appearance, if appropriate, for the site. Photo 6-31 shows some newly constructed low-gradient bank benches.

**6.4.2.4 Seeding and Mulching.** In all these practices, proper seeding is essential. Seeding requires:

1. An initial site evaluation (physical condition, soil tests)
2. Soil preparation (tilling & soil supplements)
3. Selection of species (temporary and permanent cover)
4. Timing of seeding (spring, fall preferred)
5. Establishment procedures (seeding methods, mulching).

The purpose of the initial site evaluation is to determine all site factors, both physical and chemical, which may limit the adaptability of various plant species to the site – moisture, temperature conditions, deficiency of vital soil nutrients, and any materials in the soil which are toxic to plants.



**6-31 Newly constructed low-gradient bank benches.**



**6-32 Soil: Grab a handful, squeeze; does your hand stay “dirty”?**

Soil tests determine a majority of this information. You can also get an idea about the soils by getting your hands dirty. Grab a handful, squeeze to check for moisture and clay content. Does it stick together? Does your hand stay “dirty” due to clay? (Refer to Appendix 6A: Soil Identification in the Field.) The optimum condition would be to work lime and fertilizer into the top 12 inches of soil for planting. The soil does need to be loosened by tilling with proper supplements added for good plant growth.

Selection of species is also important. In most applications, a seed mix of fast-growing nurse grass and the desired long-term plants will work well. Nurse grasses, such as rye grass, rye grain, and redtop, grow fast, binding the soil and sheltering slower germinating seeds, and give a good first impression of re-vegetation.

Legumes are a good component of the seed mixture. Legumes fertilize the soil by adding nitrogen to the soil, aiding the other plant types. Examples of legumes would be clover, flat pea, and bird’s foot trefoil.

Time of seeding varies on geographical location. Generally, prior to mid-June and from mid-August to mid-September are the best times. This is somewhat a function of soil temperature, so summer can work, but make sure enough water is added with a good layer of mulch.

Establishment procedures refer to seeding methods and mulching. Broadcast spreaders are commonly used for road banks and the scale of most projects. Seeds can be sown by hand or a cyclone spreader as well. Hydroseeding is a spray mix of water, seed and fertilizer onto the bank. Hydromulching takes the above mixture and adds mulch.

Mulching is a requirement to hold and protect the seed. After mulching, the ground should not be visible. More mulch should be used in the summer and fall to protect from heat and frost, respectively. As another rule of thumb, if using hay or straw bales and the job requires more than thirty bales, get (rent) a power mulcher. Anyone who has shaken bales for mulching will gladly accept this rule of thumb.

Straw is cleaner than hay (no seeds) and provides good coverage with a mulcher. Hay is loaded with seeds and is easier spread by hand. Hydromulching, usually green in color, put in the hydroseed mix, may also be used.

The photo shows a vertical slope that has been seeded and mulched. This is a drainage inlet construction site where the bank had to be removed for inlet installation. The terrain and other conditions such as trees and a driveway directly above dictated the vertical slope. But it was not left bare to erode away with the first rainstorm. This is actually a straw mat, straw stitched into a flat mat and manufactured in rolls, and pinned to the bank. Wet down the mat, sprinkle seeds on it and then pin it to the bank. There are mats that are already impregnated with seed that can be used effectively. Leaving bare soil will only result in [erosion](#) and [sediment](#) and additional maintenance work and cost.



**6-33 Rolled seed-impregnated straw blankets can be pinned to steep slopes for re-establishment of vegetation.**

Started plants can be used, but are normally limited to small sites where it is hard to get plants to grow from seed. Started plants include pachysandra, day lilies, and periwinkle and are commonly available.

Although this was only a quick overview of seed mixtures and seeding, there are some valuable resources and expertise available. Working closely with the local and state conservation agencies, Departments of Agriculture, College/University Extension Offices is necessary for most local road departments, since road personnel do not generally have expertise in this area. As an additional advantage to consulting the experts, some species are invasive and should not be used.

**6.4.3 Bioengineering Techniques.** [Bioengineering](#) techniques are being used effectively in restoration of many stream and [upland](#) banks. [Bioengineering](#) combines the biological elements of using live plants with engineering design concepts for slope protection and [erosion](#) reduction. Although not the solution to all slope failure and surface [erosion](#) problems, many [bioengineering](#) techniques can be used in combination with other techniques and practices.

[Bioengineering](#) takes a holistic approach, gauging factors such as environmental compatibility, use for difficult sites, cost effectiveness, and the biotechnical strengths of the systems. Many [bioengineering](#) practices can be used in wet areas with minor disturbance to the site, enhancing the environmental sensitivity benefit. Hand labor is usually a necessity, but this becomes a benefit for those difficult sites where the use of machinery may not be feasible. That same labor lends again to the cost effectiveness

where labor rates are reasonable. The cost effectiveness of these practices really stems from the resulting low/no maintenance conditions when the work is completed. As the vegetation becomes established, the initial biotechnical strength of these systems only enhances. Growing roots reinforce the soils and extract excess moisture, while the foliage breaks raindrop impact, reduces surface water velocity, and prevents surface [erosion](#).

[Bioengineering](#) makes use of local vegetation. Local vegetation is already suited to the climate, soil, and moisture conditions. Installation is accomplished during the dormant season, making the plants easier to handle. A few of the more common plant materials are bank willows and shrub dogwoods, which have been very successful in these installations. Willows would serve well in the practices described below.

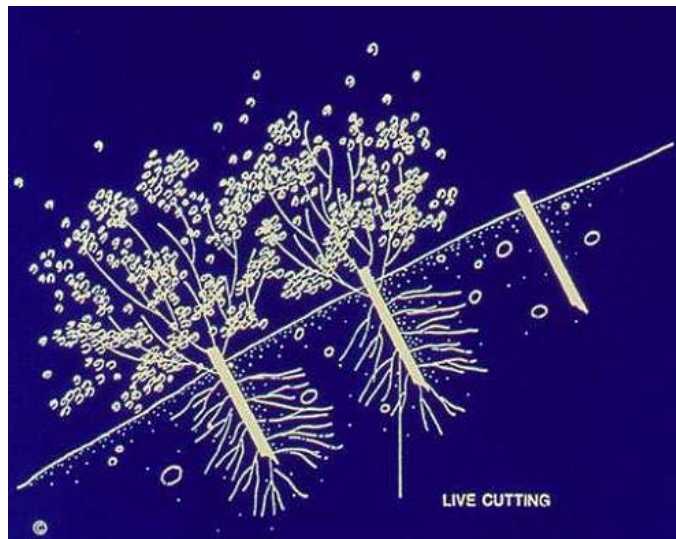


**6-34 Bank willows are commonly used in bioengineering practices.**

Common techniques are live stakes, live fascines, brushlayers, branchpacking, and joint planting. These are the more simple techniques that lend themselves to volunteer labor. These techniques and others are thoroughly described in the **U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), Engineering Field Handbook, Chapter 16, Streambank and Shoreline Protection, and Chapter 18, [Bioengineering](#) for Upland Slope Protection and Erosion Reduction**. This handbook provides the data and details on many [bioengineering](#) practices. In addition, NRCS personnel can be quite helpful in providing advice and assistance in these techniques for any site or project being contemplated.

To clarify the use of these techniques and show the advantages and benefits, we will discuss a few of the more common practices accompanied by several photos.

**6.4.3.1 Live Stakes.** This practice consists of inserting and tamping live, rootable vegetative cuttings into the ground, as shown in Figure 6-8. Once the dormant stakes begin to grow, they create a living root mat and foliage. The primary function of this technique is to reduce soil [erosion](#) by slowing water velocities and by reinforcing the soil with root masses. Construction can be inexpensive and accomplished in a short time frame.



**Figure 6-8: Live Stakes**



**6.35 Cutting the stakes and Preparing the site.**

The live stakes are cut to the required length. The site is prepared. The project site depicted in the photo shows some [riprap](#) armoring at the water edge and rolled biodegradable [erosion](#) protection matting being laid. The tops of the live stakes are then driven into the ground.



**6-36 Driving the Stakes.**



**6.37 Completed site and after one season's growth.**

The top of the stake is usually the slightly smaller diameter end and will make driving it into the ground a little easier. The plant will produce roots and foliage appropriate to its orientation. A pilot hole can be made and a dead blow hammer can be used to reduce damage to the cutting. If the end of the stake is damaged (flattened

and splayed), simply cut off the damaged part. The final photos show a completed site and one after a season's growth.

**6.4.3.2 Live Fascines.** Live fascines are long bundles of branch cuttings bound together and placed in shallow contour trenches on the slope. The function is to protect the slope from shallow slides and reduce surface [erosion](#). This technique is suited to steep, rocky slopes where digging is difficult.



**6.38 Tying the bundles and digging the trench.**

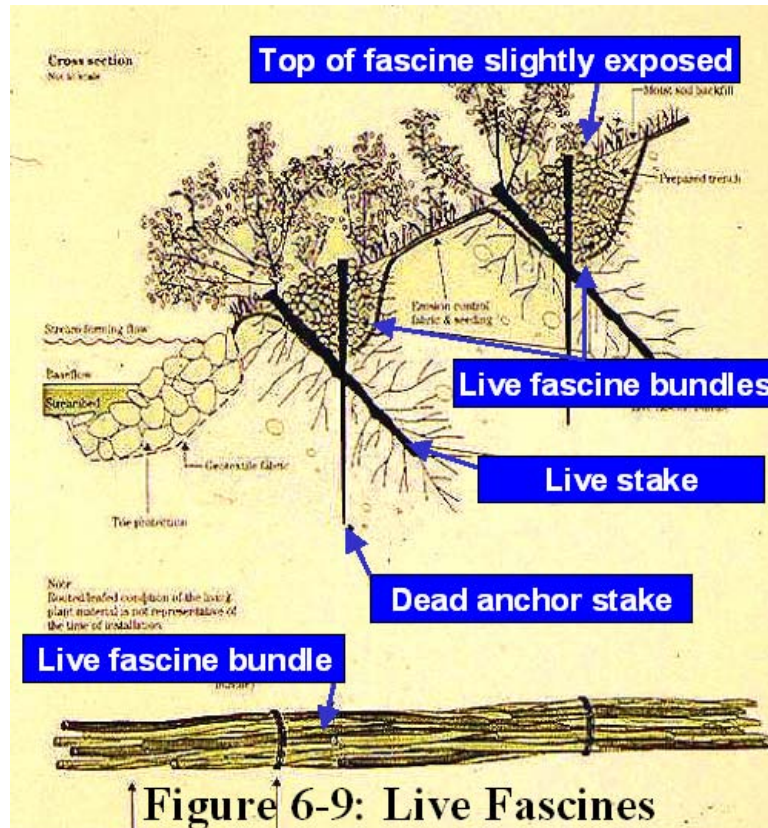
The branches are cut and the cuttings tied together to form long fascine bundles. Beginning at the base of the slope, a trench is dug on the contour of the slope. The fascine bundle is placed in the trench and staked. Live stakes can be used in combination with this technique.



**6.39 Placing the fascine and backfilling.**

The live stakes are placed on the downslope side of the bundle as shown in Figure 6-9. Backfill soil is then used to fill around the bundles keeping the top of the fascine slightly exposed. The last photo shows a completed spring site after a summer's growth.

As with many of the [bioengineering](#) practices, this technique lends itself to volunteer labor, as one can see in the above photos. These projects seem particularly desirable to many different groups with the volunteers receiving substantial satisfaction from a job well done and the continued satisfaction of the continual site enhancement.



6-40 Fascines after one season's growth.

emphasized. Roadside vegetation prevents [erosion](#) and [sedimentation](#) pollution and results in lower road maintenance costs. Additionally, a well-vegetated roadside is naturally beautiful and can be a draw for tourists.

We not only discussed the importance of roadside vegetation, but we demonstrated how we can effectively use vegetation to our advantage in reducing maintenance and costs and prolonging road life. We can actually use the forest system and other plants to create benefits for the environment, the roadway, and local governments.

Media publicity can also be a positive factor in promoting the volunteer group and the project. From Boy Scouts and Girl Scouts to 4H Clubs, from service organizations (Rotary International, Kiwanis, etc) to [watershed](#) and conservation groups, volunteers are a great resource for accomplishing these projects.

## 6.5 Summary

Throughout this chapter, the importance of roadside vegetation was

We covered various proven techniques that can be utilized, particularly for bank stabilization. We pointed out that if all the eroded banks along our roads would be revegetated, both the large and small sites, a substantial reduction in pollution and associated road maintenance would result. We mentioned easy to use [bioengineering](#) techniques that can be accomplished with in-house crews or volunteer work from the many available groups and organizations.

We talked about seeding and the important steps in the revegetation process. And particularly in this area, we emphasized using the available valuable resources in your respective geographical location.

To again see these practices used in actual projects, we refer back to Appendix 5, Section 5A-1 for Worksite #1, Red Rose Road, Huntington County, PA. Adding to that site, Appendix 6B provides an additional project site utilizing vegetation practices. As in Appendix 5, this “Worksite in Focus” reviews an actual Pennsylvania worksite in which a combination of practices has been used to solve the [erosion](#) and [sediment](#) pollution problems.

We also need to re-emphasize that all of these practices can be adopted for paved roads and will prove to be just as beneficial as they are for unpaved gravel roads. And by using these practices, you will again see the long-range continual benefits for your roads and your environment and thereby for your community.